a main air flow passageway extending through said spaced apart rings and being sized to receive an axial fan with propeller blades extending towards a radially inward edge of the flow augmenting rings to deliver a main flow of air in an axial direction along said main air passageway toward the base plate and with a gap between the propeller blades and the inner radial edge of the rings selected to enable production of tip vortices from the propeller tips; and with [the] average ring chordal dimensions being effectively selected with respect to a radial dimension of the main air flow passageway so as to enable tip vortices from the propeller blades to be converted to useful air flow along said axial direction with a radially inwardly induced secondary air flow between and over said heat conducting flow augmenting rings that is a significant portion of [the] total mass flow generated along said main air flow passageway;

at least one solid heat conducting column extending from said base plate to support said rings and being in heat conducting relationship therewith [said base plate] so as to transfer heat from the base plate to said heat conducting flow augmenting rings;

the axial dimension [width] of said air pumping aperture between axially adjacent heat conducting flow augmenting rings being selected so as to enable said tip vortices to extend into the aperture and impinge upon radially inner regions of the rings and produce a [n annular area] region on at least one of said rings having a heat transfer coefficient H_c of at least about 50 [75] Watts/m^2/EC; so as to impart to said heat sink with said flow augmenting rings a high overall heat transfer characteristic H_c;

whereby the thermal resistance of said heat sink, when combined with said axial fan within the main air flow passageway, is reduced to a sufficiently low level so as to significantly enhance the removal of heat from said heat generating device.

2. (Amended) The heat sink as claimed in claim 1 wherein said axial width between said flow augmenting rings and the average ring chordal dimension are selected so as to impart to the combination of said heat sink and said flow augmenting rings an overall heat transfer coefficient H_c that is at least above about 75 [50] watts/m^2/EC.

3. (Amended) The heat sink as claimed in claim 1 wherein said base plate is provided with spaced apart heat conducting elements extending upwardly from said base plate towards said flow augmenting rings [said axial width between said flow augmenting rings and the average ring chordal dimension are selected so as to impart to the combination of said heat sink and said flow augmenting rings an overall heat transfer coefficient H^c which is at least above about 75 watts/m^2/EC].

4. (Amended) The heat sink as claimed in claim 1 wherein said heat conducting body further comprises [an] said air pumping aperture having [an] said axial width sufficient to enable the radial inflow of air to comprise at least about twenty percent of the mass flow through said main air passageway.

16. (Amended) A heat sink for removing heat from heat generating devices comprising:

a solid heat conducting body having a base plate for placement in heat conducting relationship with the heat generating device and a plurality of spaced apart heat conducting flow augmenting rings with at least one air pumping aperture between the rings; at least one elongate column affixed to said base plate and coupled to support said flow augmenting rings above said base plate so as to transfer said heat from the base plate to said heat conducting flow augmenting rings;

a main air flow passageway extending through said spaced apart flow augmenting rings;

an axial fan sized to fit inside the main air flow passage way and having propeller blades which extend towards a radially inward edge of the flow augmenting rings to deliver a main flow of air in an axial direction along said main air passageway towards said base plate and with a gap between the propeller blades and the inner radial edge of the rings selected to enable production of tip vortices from the propeller tips;

the axial dimension [width] of said air pumping aperture between axially adjacent heat conducting flow augmenting rings being selected so as to enable said tip vortices to extend into the aperture and impinge upon radially inner portions of the rings and with an

[the] average plate chordal dimensions being effectively selected with respect to a radial dimension of the main air flow passageway so as to enable tip vortices from the propeller blades to be converted to useful air flow along said axial direction with a radially inwardly induced secondary air flow between and over heat conducting flow augmenting rings so as to impart to said heat sink with said flow augmenting rings a high overall heat transfer coefficient H_c;

whereby the thermal resistance of said heat sink, when combined with said axial fan within the main air flow passageway, is reduced to a sufficiently low level so as to significantly enhance the removal of heat from said heat generating device.

18. (Amended) The heat sink as claimed in claim 16 [wherein said] wherein the axial width of said pumping aperture between flow augmenting rings and the average plate chordal dimension are selected so as to impart to the heat conducting body an overall heat transfer coefficient H_c that is at least above about 75 watts/m^2/EC.

23. (Amended) A method for removing heat from a heat generating device comprising the steps of:

embedding a rotating fan having axially extending propeller in a heat sink having a plurality of surrounding axially spaced flow augmenting rings so as to produce a primary flow of air towards the heat generating device;

conducting heat through a solid body from the heat generating device to the flow augmenting rings;

directing tip vortices from the propeller onto radially inner regions of the rings so that these inner regions are cooled by the tip vortices and by an induced radially inward flow of secondary air through [the] spacings between flow augmenting rings so as to impart to said inner regions a heat transfer coefficient that exceeds about 50 [75] watts/m^2/EC.

25. (Amended) The method as claimed in claim 23 wherein said tip vortices directing step comprises the step of directing the tip vortices to extend into [the] axial ring spacings sufficiently to remove a significant amount of heat from inner ring regions for a measurable radial distance that is about 25% of the radius of the propeller.

26. (Amended) A heat sink for heat generating devices comprising:

a heat conducting solid body having a base plate for placement in heat conducting relationship with the heat generating device and a plurality of spaced apart heat conducting flow augmenting rings with at least one air pumping aperture between the rings;

a main air flow passageway extending through said spaced apart rings and being sized to receive an axial fan with propeller blades extending towards a radially inward edge of the flow augmenting rings to deliver a main flow of air in an axial direction along said main air passageway towards the heat generating device and with a gap between the propeller blades and the inner radial edge of the rings selected to enable production of tip vortices from the propeller tips; and with [the] average ring chordal dimensions being effectively selected with respect to a radial dimension of the main air flow passageway so as to enable tip vortices from the propeller blades to be converted to useful air flow along said axial direction with a radially inwardly induced secondary air flow between and over said heat conducting flow augmenting rings;

said rings being directly coupled to extend from said base plate so as to transfer heat therefrom;

the axial dimension [width] of said air pumping aperture between axially adjacent heat conducting flow augmenting rings being selected so as to enable said tip vortices to extend into the aperture and impinge upon radially inner regions of the rings;

whereby the thermal resistance of said heat sink, when combined with said axial fan within the main air flow passageway, is reduced to a sufficiently low level so as to significantly enhance the removal of heat from said heat generating device.

27. (Amended) A heat sink for heat generating devices comprising:

a heat conducting solid body for placement in heat conducting relationship with the heat generating device and a plurality of spaced apart heat conducting flow augmenting rings with at least one air pumping aperture between the rings;

a main air flow passageway extending through said spaced apart rings and being sized to receive an axial fan with propeller blades extending towards a radially inward edge of the flow augmenting rings to deliver a main flow of air in an axial direction along said main air passageway towards said heat generating device and with a gap between the propeller blades and the inner radial edge of the rings selected to enable production of tip vortices from the propeller tips; and with [the] average ring chordal dimensions being effectively selected with respect to a radial dimension of the main air flow passageway so as to enable tip vortices from the propeller blades to be converted to useful air flow along said axial direction with a radially inwardly induced secondary air flow between and over said heat conducting flow augmenting rings;

a heat conducting column in the form of a cooling pipe for heat conducting relation ship with said heat generating device and coupled to support said flow augmenting rings and transfer heat thereto;

the axial dimension [width] of said air pumping aperture between axially adjacent heat conducting flow augmenting rings being selected so as to enable said tip vortices to extend into the aperture and impinge upon radially inner regions of the rings;

whereby the thermal resistance of said heat sink, when combined with said axial fan within the main air flow passageway, is reduced to a sufficiently low level so as to significantly enhance the removal of heat from said heat generating device.

Remarks

This amendment is presented in response to the Official Action of March 8, 1999. A petition to extend the time to respond together with the required fee are enclosed.

The Examiner has rejected the claims on the basis of double patenting and has indicated that a timely filed terminal disclaimer can be used to avoid this rejection. In re-